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POLICE STATION of ACROPOLIS

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No 1882243, issued on 05.12.1978

Athens, 19.07.2002

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THE HELLENIC INDUSTRIAL PROPERTY ORGANISATION

PATENT

No 1003569

Taking into account:

- a) Article 8, par. 11 of the Greek Law 1733/87 on "Technology transfer, inventions, technological innovations and setting-up of an Atomic Energy Committee"
- b) The Ministerial Decision 15928/ΕΦΑ/1253 of the Greek Ministry of Industry, Energy and Technology on "Filing for an application for a Patent or Utility Model Patent before the Hellenic Industrial Property Organisation and record keeping"
- c) The application filed by the person concerned before the Hellenic Industrial Property Organisation on **07.03.2000** under No 20000100073

We confer

This Patent accompanied by all relevant and attached documents certified according to the Greek Law, to:

1) **AGATZINI-LEONARDOU STYLIANI (70%)**

VALTINON 76

114 74 ATHENS

2) **DIMAKI DIMITRA (30%)**

THEOTOKI 23

146 63 ATHENS

THE PATENT NO.1003569 IS A PATENT OF ADDITION TO THE PATENT NO.1001555/31.05.91.

TITLE: "METHOD FOR EXTRACTION OF NICKEL AND/OR COBALT FROM NICKEL AND/OR COBALT OXIDE ORES BY HEAP LEACHING WITH A DILUTE SULPHURIC ACID SOLUTION, PREPARED FROM SEA WATER AT AMBIENT TEMPERATURE."

INVENTORS: 1) AGATZINI-LEONARDOU STYLIANI 2) DIMAKI DIMITRA
INTERNATIONAL CLASSIFICATION (INT.CL⁷) C22B 23/00, C22B 3/08.

This Patent is valid until: **01.06.2011**.

Athens, 23 April 2001

The General Manager

EMMANOUIL SAMOUILIDIS

Signature and Seal



CLAIMS

1.The method for extraction of nickel and/or cobalt from nickel and/or cobalt oxide ores by heap leaching with a dilute sulphuric acid solution, prepared from sea water, at ambient temperature applies the technique of heap leaching for the extraction of nickel and/or cobalt from nickel and/or cobalt oxide ores using multiple recycling of the dilute sulphuric acid leach solution, the acid concentration of which may be optionally adjusted to a predetermined value depending on the technique used (I or II), through one or more heaps and it is characterized by the use of sea water, replacing fresh water, for the preparation of the dilute sulphuric acid solution, which acts as the leaching agent, as well as by the presence of sodium ions, originating from the sea water, in the produced leach liquor (pregnant solution), rendering the addition of cations such as K^+ , Na^+ , NH_4^+ not necessary in the subsequent stage of iron removal as jarosite from the nickel and/or cobalt containing leach liquor (pregnant solution) while the final concentrations and percent extraction values of nickel, cobalt, iron, chromium and aluminium, the ratio Fe/Ni in the leach liquor and the mechanism of the ore leaching remain unchanged.

2.the method for extraction of nickel and/or cobalt from nickel and/or cobalt oxide ores by heap leaching with a dilute sulphuric acid solution, prepared from sea water, at ambient

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temperature, according to claim 1, is characterized by that the use of sea water increases the final magnesium and calcium concentrations of the produced leach liquor (pregnant solution) without, however, affecting the percent extraction of these elements from the ore.

3.the method for extraction of nickel and/or cobalt from nickel and/or cobalt oxide ores by heap leaching with a dilute sulphuric acid solution, prepared from sea water, at ambient temperature, according to claims 1 and 2, is characterized by that any type of water, irrespective of its chemical composition, can be used without affecting nickel and cobalt extraction from the ore or the ore leaching mechanism, while, at the same time, the produced leach liquor(pregnant solution) can contain higher concentrations of magnesium, calcium and sodium, depending on the type of water used, than those contained in fresh water, thus increasing the recoverable quantities of these cations from the produced leach liquor(pregnant solution) and facilitating the subsequent treatment of the leach liquor.

4. The method for extraction of nickel and/or cobalt from nickel and/or cobalt oxide ores by heap leaching with a dilute sulphuric acid solution, prepared from sea water, at ambient temperature, according to claims 1,2 and 3, is characterized by that any type of industrial or municipal effluent water stream, free of solid residues, can be used for the

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preparation, of the dilute sulphuric acid solution required for the application of the method, without affecting either the percent extraction values of nickel and/or cobalt from the nickel and/or cobalt oxide ore or the ore leaching mechanism.

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19.7.2002/SEAL

True translation of the attached greek document

Athens 25.7.2002

S.Spanoudakis

Translator

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ABSTRACT

METHOD FOR EXTRACTION OF NICKEL AND/OR COBALT FROM NICKEL AND/OR COBALT OXIDE ORES BY HEAP LEACHING WITH A DILUTE SULPHURIC ACID SOLUTION, PRODUCED FROM SEA WATER AT AMBIENT TEMPERATURE

The invention relates to the use of sea water or water of various chemical compositions or municipal effluent streams, free of residual solids, for the preparation of the dilute sulphuric acid solution required for the application of the hydrometallurgical method for the extraction of nickel and/or cobalt, in the form of an aqueous solution containing nickel and cobalt cations, from nickel and/or cobalt oxide ores by heap leaching with a dilute sulphuric acid solution at ambient temperature. It concerns an improvement of the method described in Patent GR1001555.

The proposed method renders possible or more economic the extraction of nickel and/or cobalt from nickel and/or cobalt ores by heap leaching with dilute sulphuric acid, at ambient temperature, also in regions where fresh water is either not available or costly, without affecting the ore leaching mechanism or the subsequent treatment of the produced leach liquor (pregnant solution).

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In various applications of the method, there were used samples of sea water, industrial and municipal effluents in order to prepare solutions of dilute sulphuric acid which were used as the leaching agents for the extraction of nickel and cobalt from nickel and cobalt oxide ores by heap leaching at ambient temperature and the leachability of such ores by heap leaching was fully studied.

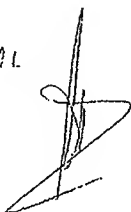
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